INTRODUCTION

The leading detector for low-photon-flux detection at present is the **vacuum photomultiplier tube**. This device with a GaAs cathode has sufficient gain (~10^6) and sufficiently low dark current (~ 1 nA) to achieve shot-noise-limited performance, but still has a quantum efficiency of only 5%~ 6%.

Another type of device, **silicon avalanche photodiodes (SiAPDs),** would have the advantage of solid-state reliability and the higher quantum efficiency of Si (~ 80%). However, SiAPDs have limited gain (10-100), relatively high dark current and high sensitivity to temperature changes. An alternative device is the solid-state photomultiplier.

Among them, the **Si metal-oxide-semiconductor (MOS)** photomultiplier **(SiMOS PM)** is of particular interest. The reported characteristics of this device approach those for vacuum photomultipliers while maintaining the high quantum efficiency characteristic of silicon.

This paper presents results of an investigation of the operating mechanisms of the solid-state MOS photomultiplier (SiMOS PM).

The potential utilization of such a device as a photodetector was discussed by:

1. N. A. Foss, S A. Ward [1973],
2. N.Galbraikh et al [1975],
3. S. Savransky et al [1986],
4. V.Zalessky et al [1986]

An experimental study of the MOS photomultiplier was made here using Si MOS PM (array detector) as the test devices.

In this paper, a semi quantitative description of the MOS photomultiplier and associated device physics is presented.

A description of the experimental approach utilized is then given. Experimental results are discussed and insights regarding the operation of MOS devices in the avalanche regime are described.

Finally, conclusions and recommendations regarding the practical use of the MOS photomultiplier are presented,